

ACARINA OF AUSTRALIA AND NEW GUINEA
THE FAMILY LEEUWENHOEKIIDAE

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[Read 10 May 1945]

In 1944 (Trans. Roy. Soc. S. Aust., 68, (1), 102) the present writer erected the subfamily Leeuwenhoekinae for the larval genus *Leeuwenhoekia* Ouds. 1911, on the discovery of a true stigmal opening situated on each side between coxae I and the gnathosoma, from which tracheal tubes ramify through the body. In this feature the species of *Leeuwenhoekia* s.l. differ from the other genera of the Trombiculinae.

I am now convinced that such a fundamental character justifies raising the group to familial rank, and in this paper propose the family Leeuwenhoekidae. I am more disposed to do this as Ewing recently (1944 Proc. Biol. Soc. Wash., 57, 101-104) raised the Trombiculinae to Trombiculidae.

In 1944 (*loc. cit.*) it was suggested that the allied genus *Hannemannia* Ouds. might also be found to possess similar true stigmal organs, but as that genus has not yet been found to be represented in Australia, I had not seen any species. Through the kindness of Sq./Ldr. C. D. Radford, however, I have recently been privileged to study a mount of *Hannemannia ochratoma* Radford from a pika from Rassis Hole, Montana, U.S.A., and can now affirm that this genus, which in the larvae is closely related to *Leeuwenhoekia*, also possesses a true stigma on each side between the gnathosoma and coxae I.

In the Journal of Parasitology, 1942, 28, Ewing subdivided the genus *Leeuwenhoekia* Ouds., retaining *Leeuwenhoekia* s.str. only for the genotype, *verduni* Ouds. 1910. The remaining known species he placed in two new genera *Comatacarus* and *Acomatacarus*.

Leeuwenhoekia s.str. was diagnosed as having the dorsal setae relatively few and arising from tubercles, the postero-lateral scutal setae differing from the others in being distally thickened or clavate, and the chelicerae serrated. The other two genera have more dorsal setae but not set on tubercles, and the postero-lateral scutal setae similar to the others. In *Comatacarus* the chelicerae possess only a single dorsal and a single ventral tooth; in *Acomatacarus* the chelicerae are serrated. In the last genus Ewing placed the Australian species *L. australiensis* Hirst and two other species.

In the same paper Ewing also agreed that the peculiar quill infesting genus *Apolonia* Torres and Braga 1939, as the authors suggested, was closely related to *Leeuwenhoekia*.

Hitherto the above genera only have been known, and these only from the larvae. Recently, however, Major G. M. Kohls of the American Scrub-Typhus Commission, has been successful in rearing fully engorged larvae of two species of *Acomatacarus* to the nymphal stage, while Lt.-Col. C. B. Philip has reared the nymph of a third species. Three species, previously referred to the Microtrombiinae, and known only from the adults, also agree with these nymphs, and are placed here in *Acomatacarus*.

For the readiness with which the above colleagues have entrusted their material to the writer for taxonomic study I tender my grateful appreciation.

Family **Leeuwenhoekiiidae** nov.

= *Leeuwenhoekiiinae* Womersley 1944, Trans. Roy. Soc. S. Aust., 68, (1), 102.

Diagnosis of Larvae—Typical Trombidiid larvae, with pseudostigma (urstigma) between coxae I and II, and on each side between gnathosoma and coxae I a true stigmal opening, from the atrium of which tracheal tubes traverse the body. With a single dorsal scute furnished with 2 antero-median, 2 antero-lateral and 2 postero-lateral setae (absent in *Apolonia*), as well as a pair of filamentous sensillae; anteriorly the scutum with or without a median tongue-like process. All tarsi with similar paired claws and median longer claw-like empodium.

Diagnosis of Nymphs—Typical Trombidiid facies, rather elongate, widest across the shoulders and distinctly narrowing behind but without the characteristic medial constriction of the Trombiculidae. Eyes present or absent, if present then 2 + 2, sessile and away from crista. Crista elongate, linear, with sub-posterior sensillary area furnished with two long filamentous sensillae; anteriorly the crista is expanded into a characteristic rounded or arrow-head-shaped nasus carrying two long, normally ciliated setae which are probably homologous with the antero-median scutal setae of the larvae. Palpi rather slender, tibia with strong apical claw, no accessory claw, but several strong spines instead, without pectines. Chelicerae finely serrated on inner edge. Legs long and slender, I and IV longer than body. Dorsal setae varied. Genital organs with two pairs of discs.

Diagnosis of Adults—As in nymphs but of larger size and genitalia with 3 pairs of discs, except in *Neotrombidium* which has only 2 pairs of elongate oval discs.

Within this family would also appear to belong the genus *Neotrombidium* Leonardi 1901, which was included in the subfamily Microtrombidiinae by Sig Thor 1935 and Womersley 1937. It only differs from the other adult genus known, *Acomatacarus*, in that the nasus is more or less rounded and not arrow-head-like.

KEY TO THE LARVAL GENERA OF LEEUWENHOEKIIDAE

- | | | | |
|---|---|--|---|
| 1 | Dorsal scutum without anterior median process. Both AL and PL scutal setae present. | Both AL and PL scutal setae present.
<i>Hannemannia</i> Ouds. 1911
type <i>hylodeus</i> Ouds. 1910 | |
| | Dorsal scutum with an anterior or median tongue-like process. | | 2 |
| 2 | PL scutal setae wanting. | <i>Apolonia</i> Torres & Braga 1939
type <i>tigipioensis</i> Torr. & Braga 1939 | |
| | PL scutal setae present. | | 3 |
| 3 | PL scutal setae distally thickened and differing from AL. Dorsal setae relatively fewer and arising from tubercles. Chelicerae with a row of blunt teeth. | <i>Leeuwenhoekia</i> Ouds. 1911
s. str. Ewing 1942
type <i>verduni</i> Ouds. 1910 | |
| | PL and AL scutal setae similar and not thickened distally. Dorsal setae more numerous and not on tubercles. | | 4 |
| 4 | Chelicerae with only a single dorsal and a single ventral tooth, and not obliquely flattened distally. | <i>Comatacarus</i> Ewing 1942
type <i>americanus</i> Ewing 1942 | |
| | Chelicerae with a row of teeth on upper margin. | <i>Acomatacarus</i> Ewing 1942
type <i>arizonensis</i> Ewing 1942 | |

KEY TO THE KNOWN NYMPHAL AND ADULT GENERA OF LEEUWENHOEKIIDAE

- 1 Anterior nasal expansion of crista arrow-head shaped. Eyes present or absent. Dorsal setae varied. *Acomatacarus* Ewing 1942
 Anterior nasal expansion of crista more or less rounded. Eyes present. Dorsal setae trifurcate. *Neotrombidium* Leonardi 1901

Genus ACOMATACARUS Ewing 1942

Jour. Parasitology 1942, 28, 490 (Genotype *A. arizonensis* Ewing 1942).

In this genus, as defined by Ewing, will come all the larval species previously described from Australia and New Guinea; *australiensis* Hirst, *southcotti* Wom., *mccullochi* Wom., *adelaideae* Wom., *hirsti* Wom., and *nova-guinea* Wom., as well as the new species, *longipes*, *athertonensis*, *barrinensis* and *echidnus*, described herewith.

Of the above species nymphs of both *longipes* and *nova-guinea* have been reared by Major G. M. Kohls, and more recently Lt.-Col. C. B. Philip has reared nymphs from larvae, from Hollandia, Dutch New Guinea, which I have identified as *australiensis* Hirst.

As a result of these rearings the genus *Acomatacarus* and family Leeuwenhoekiiidae can be defined as above, and several Australian Trombidiids previously referred to other genera must now be placed in *Acomatacarus*. These species are *Rhyncholophus attolus* Banks 1916, *R. retentus* Banks 1916, both considered (1934) as *Microtrombidium*, and *Dromeothrombium dromus* Wom. 1939, the last being now shown to be really two species.

The taxonomy of at least this genus of the Leeuwenhoekiiidae is particularly difficult in the larval stage, such specific characters as exist being found in the slight differences in the number of dorsal setae, and in the Standard Data of the dorsal scutum. From those few species as yet known from the nymphal and adult stages, however, the specific differences are more manifest in the form and dimensions of the dorsal body setae.

Both these features are in contrast to what is found in the Trombiculidae, where better defined specific characters are to be found in the larvae than in the nymphs and adults.

ACOMATACARUS AUSTRALIENSIS (Hirst 1925)

Leeuwenhoekia australiensis Hirst 1925, Trans. Roy. Soc. Trop. Med. and Hyg. *nec* Womersley 1934, Rec. S. Aust. Mus., 5, (2), 217; Gunther 1939, Proc. Linn. Soc. N.S.W., 64, (1, 2), 95; Womersley and Heaslip 1943, Trans. Roy. Soc. S. Aust., 67, (1), 141 (in part); Womersley 1944, Trans. Roy. Soc. S. Aust., 68, (1), 104.

Fig. 1 A-E, 5 C

Description of Nymph—Propodosoma somewhat triangular; opisthosoma elongate, rounded posteriorly. Colour in life creamy white. Length 0.6 mm., width 0.3 mm. Legs long and slender, I and IV much longer than body, I 975 μ , II ?, III ?, IV 1,275 μ , II and III missing from specimen; tarsus I elongate and almost parallel-sided, 300 μ long by 75 μ high, metatarsus I 225 μ long. Eyes absent. Crista elongate, linear (*cf.*, fig. 1 A), 216 μ long, with a large subposterior sensillary area with 2 fine filamentous sensillae apparently nude and with their bases ca. 40 μ apart; anteriorly with a large triangular arrow-head-shaped nasus carrying anteriorly a pair of ciliated setae, probably homologous with the AM setae of the larval scutum. Palpi rather long and slender, as figured; tibia with long apical claw, no accessory claw or pectines, but with 3 or 4 thick spines at base of claw; tarsus elongate, slightly over-reaching tip of claw. Chelicerae with finely serrated inner edge. Dorsal setae hardly of two distinct sizes, but varying

from 25μ to 40μ in length, with very long setules, more numerous and shorter on one side, sparser (only 2-4) on the other where one setule is fully half the length of the whole seta (cf., fig. 1 D, E).

Loc.—A single nymph bred from larvae identified by the writer as *A. australiensis* (Hirst) from Hollandia, Dutch New Guinea, 1944 (C. B. Philip).

Remarks—I am indebted to Lt.-Col. C. B. Philip of the U.S.A. Scrub Typhus Commission for the above specimen, which he succeeded in rearing. He also furnished specimens of the larvae from which the nymphal stage was reached.

Although at times the larvae of this species are common and a source of annoyance to residents of the suburbs of Sydney, a visit paid to the localities in October 1944 by the writer failed to produce either larvae or any of the later stages.

The separation of the nymph from those of other species may be made by the key on p. 110.

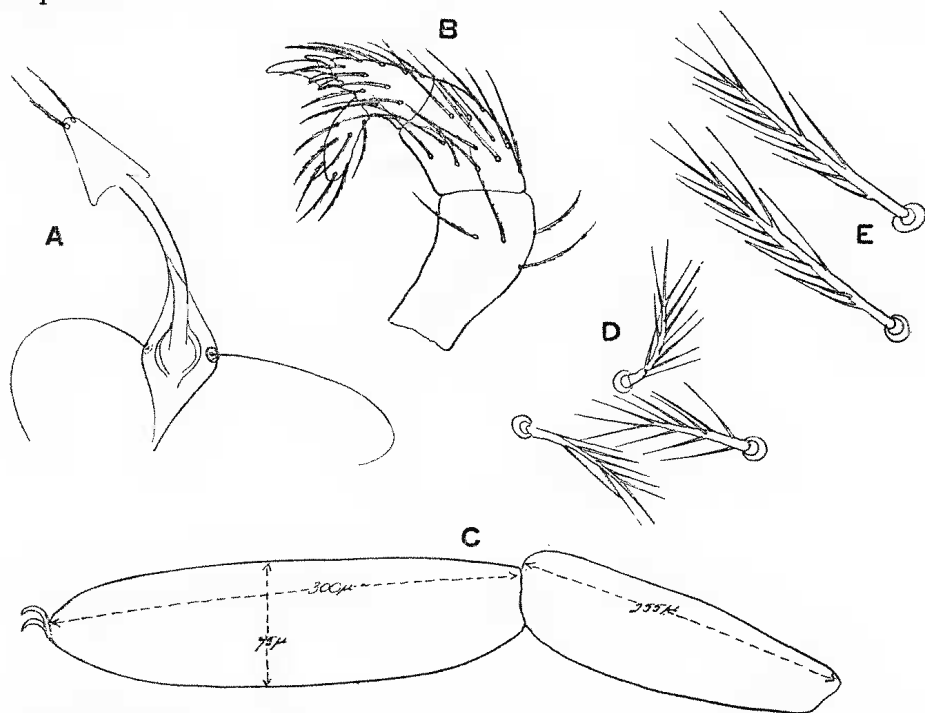


Fig. 1 *Acomatacarus australiensis* (Hirst). Nymph. A, crista; B, palp; C, front tarsus and metatarsus (x200); D, dorsal setae from propodosoma (x860); E, dorsal setae from end of opisthosoma (x860).

ACOMATACARUS NOVA-GUINEA (Wom. 1944)

Leeuwenhoekia nova-guinea Wom. 1944, Trans. Roy. Soc. S. Aust., 68, (1), 102.

Fig. 2 A-F

Description of Nymph—Propodosoma somewhat triangular; opisthosoma elongate, rounded posteriorly. Colour in life reddish. Length 0.825 mm., width 0.525 mm. Legs long and slender, I and IV much longer than body, I $1,200\mu$, II 675μ , III 750μ , IV $1,200\mu$; tarsus I elongate and almost parallel-sided, 310μ long by 82μ high, metatarsus I 218μ long. Eyes absent. Crista elongate, linear (cf., fig. 2B), 254μ long, with a large subposterior sensillary area with two fine, ca. 90μ long, filamentous sensillae with their bases 40μ apart; anteriorly with a large broad arrow-head-shaped area forming a distinct nasus and carrying anteriorly a pair of strong, thickly but shortly ciliated setae, 61μ long, probably homologous with the AM setae of the larval scutum. Palpi long and slender

(cf., fig. 2D), tibia with long apical claw, no accessory claw or pectines, but with 2 or 3 thick spines at base of claw; tarsus rather stumpy, not quite reaching tip of claw. Chelicerae as figured (fig. 2C), with the inner edge finely serrate. Dorsal

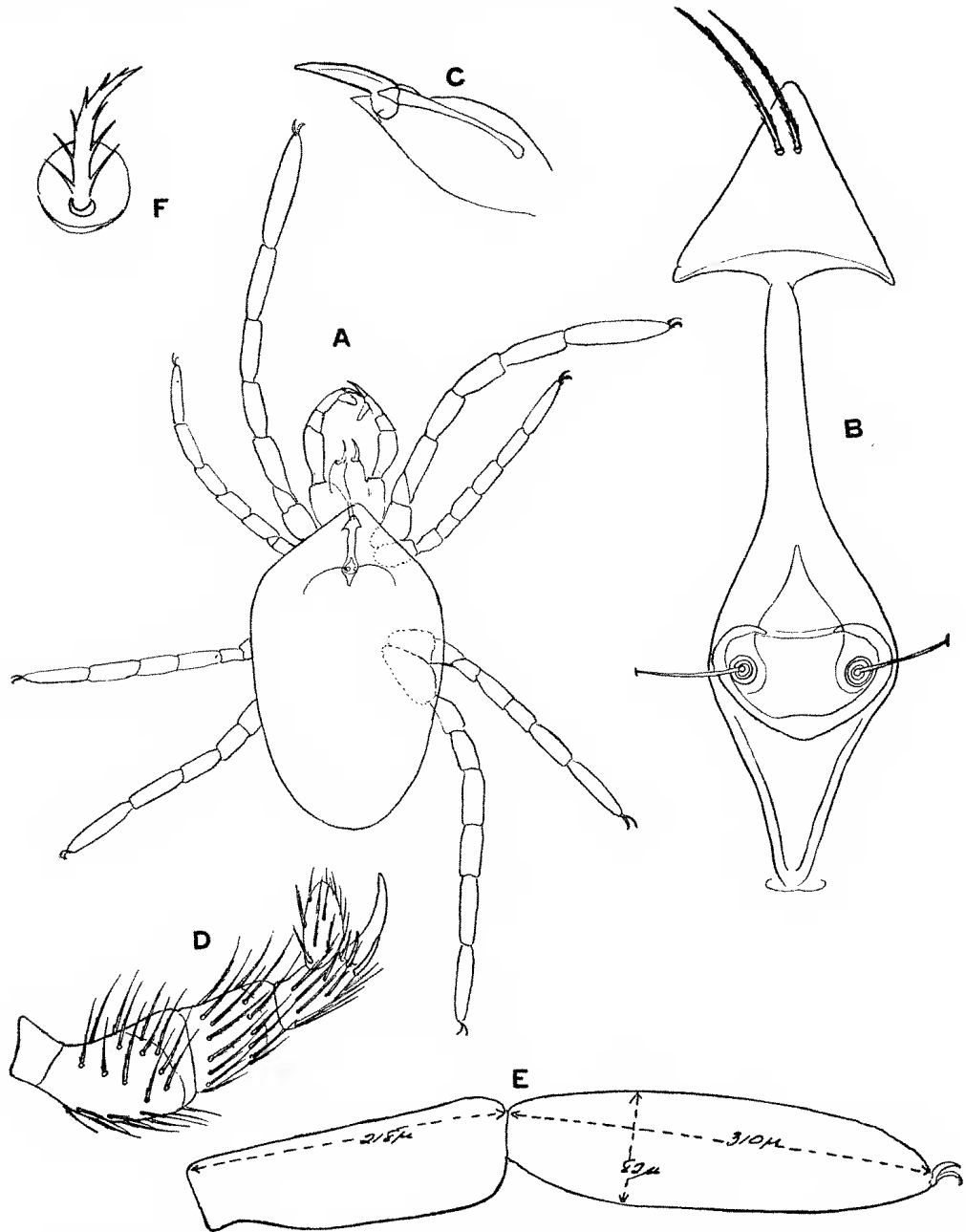


Fig. 2 *Acomatacarus nova-guinea* (Wom.). Nymph. A, entire dorsal view; B, crista (x 375); C, chela; D, palp; E, front tarsus and metatarsus (x 200); F, dorsal seta (x 860).

setae (fig. 2F) uniform in length, 25μ long, slightly curved, thick and tapering with few but basally long setules, and each seta arising from a large rounded platelet.

Loc.—The above is described from two nymphs reared by Maj. G. M. Kohls from engorged larvae identified as *L. (Acomatacarus) nova-guinea* Wom. from New Guinea, April 1944.

Walch (Goenesk. Tijdschr. v. Ned. Indie, 67, (6), 922), 1927, recorded some larval *Leeuwenhoekia* from rats in the neighbourhood of Makassar, Celebes as *L. australiensis* Hirst.

From his data and figures the following Standard Data in microns can be derived: PW 86, SB 63, AL 53, PL 67, Sens 71.

In addition the DS number 64 and are ca. 48μ long and $PW/SD = 1.36$. From these data, the Celebes material agrees more with *A. nova-guinea* than with the Australian species, and should probably be thus assigned.

Acomatacarus longipes n. sp.

Fig. 3 A-F, 4 A-E

Description of Larvae—Fig. 3 A-F. Unfed. Shape subrotund, length 450μ , width 375μ . Dorsal scutum typical of the genus, pentagonal, with the following Standard Data in microns: AW 90, PW 94, SB 32, ASB 40, PSB 29, SD 69, A-P 32, AM 40, AL 65, PL 68, Sens 60 ciliated on distal half. Anterior median scutal process 21μ long by 11μ wide; AM setae 18μ apart at bases and 14μ behind anterior margin. Scutal and dorsal setae shortly ciliated and blunt tipped. Dorsal setae 56-58 in number arranged 2.10.10.8.10.10(12).6. Palpi normal, with bifurcate tibial claw. Chelicerae dorsally serrate as in the genus. Eyes 2 + 2, about 3 diams. from postero-lateral corners of scutum. Legs normal, I 450μ long, II 405μ , III 450μ ; coxae III separated from II. Coxae I with 2 setae, II and III with one seta; no setae between coxae I, a pair between coxae III, and thereafter ca. 64 setae, beginning with a row of 12. Claws and tarsi normal. Leg III with a pair of long whip-like setae on tibiae and one on tarsus. True stigma on each side between coxae I and gnathosoma.

Description of Nymph—Fig. 4 A-E. Shape as described for *A. nova-guinea*. Length to 1.125 mm., width to 0.75 mm. across shoulders. Colour in life red. Crista elongate, linear, 405μ long, with rounded subposterior sensillary area with two long filamentous nude sensillae ca. 110μ long and their bases 47μ apart; anterior end of crista expanded into an arrow-head-shaped enlargement with a pair of long ciliated setae anteriorly. Palpi normal, fairly slender, as in *nova-guinea*, with 3-4 strong spines at base of claw. Chelicerae with finely serrate inner edge. Eyes absent. Legs very long and slender, I and IV longer than body, I $2,025\mu$, II $1,350\mu$, III $1,470\mu$, IV $2,175\mu$; tarsus and metatarsus I long and slender, tarsus I 450μ long by 120μ high, metatarsus 450μ long. Claws normal. Dorsal setae numerous and uniform, decumbent, to 30μ long, rather broad basally and tapering to a point with long ciliations (*cf.* fig. 4 D). On the legs the setae are similar, but are interspersed with some short, curved simple setae (*cf.* fig. 4 E).

Loc.—The type and 1 paratype and 1 unfed and 3 engorged larvae from the the same colony from which the nymphs were reared were sent to me by Maj. G. M. Kohls and were found on *Podargus* sp. from the Dobodura area of New Guinea, 25 July 1940 (G. M. K., 532).

Two other nymphs and several larvae, both unfed and fully engorged from a colony on honey-eaters, from the same locality, 24 May 1944 (G. M. K. 348 and 350) are also this species.

Remarks. Larva—Fig. 3 A-F. Very close to *adelaideae* Wom. 1944 in the number of dorsal setae, but differs therefrom in the wider AW and in the longer AL and PL.

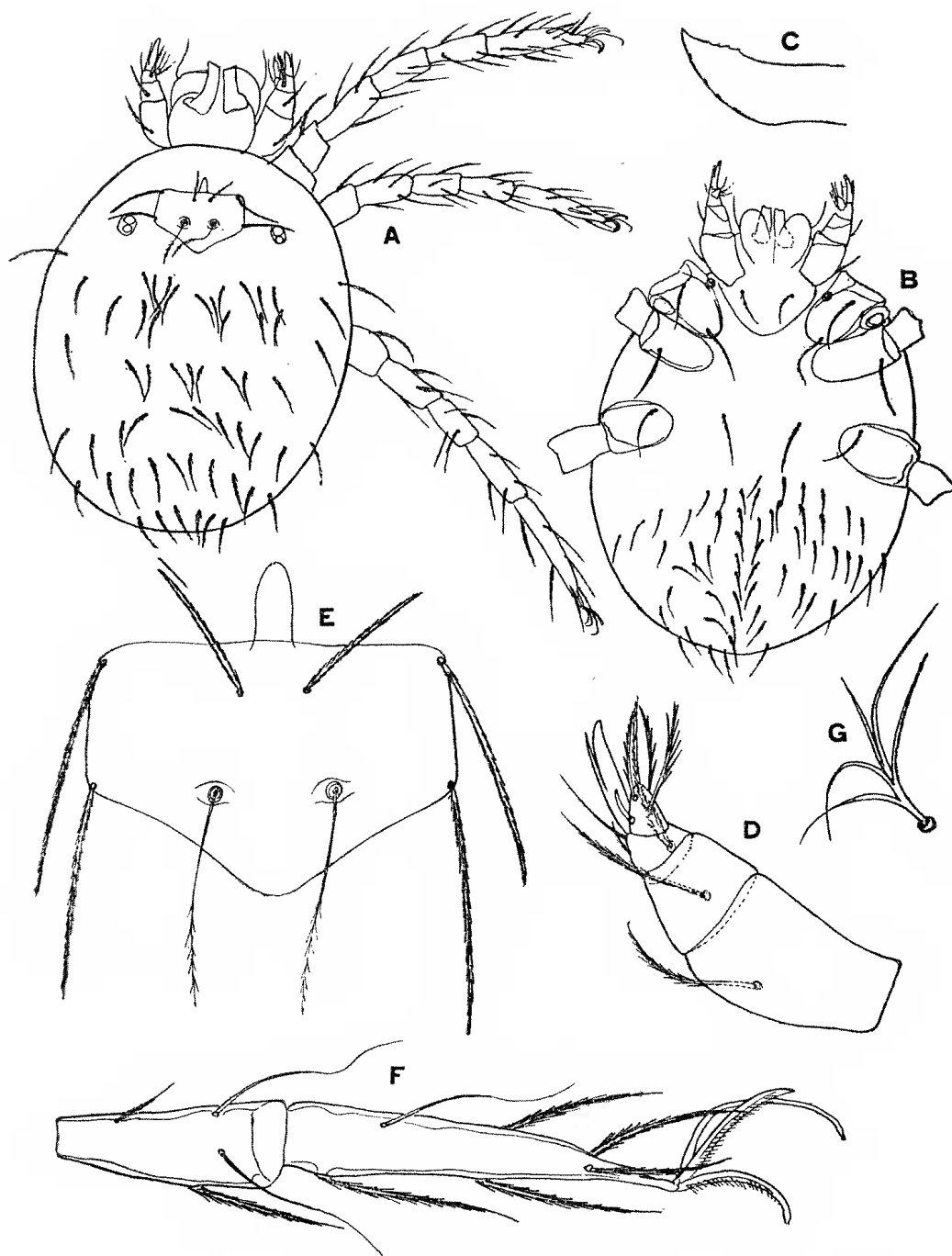


Fig. 3 *Acomatacarus longipes* n. sp. Larva. A, dorsal view; B, venter; C, chela; D, palp; E, dorsal scutum (x 500); F, hind tarsus and metatarsus.

The Standard Data in microns derived from the type, 1 paratype larva, and 5 larvae from the colony from a honey-eater are as follows:—

	Mean	Standard Deviations	Theoretical (1) Range	Observed (2) Range	Coeff. of Variation
AW - -	86.6 ± 1.17	3.11 ± 0.83	77.3 - 95.9	83.0 - 92.0	3.6
PW - -	96.7 ± 0.85	2.25 ± 0.60	90.0 - 103.4	93.0 - 101.0	2.3
SB - -	30.4 ± 0.40	1.05 ± 0.28	27.3 - 33.5	29.0 - 32.0	3.4
SD - -	72.7 ± 0.98	2.60 ± 0.69	64.9 - 80.5	68.0 - 77.0	3.6
A-P - -	31.6 ± 0.40	1.05 ± 0.28	28.5 - 34.7	29.0 - 32.0	3.3
AM - -	43.9 ± 0.55	1.46 ± 0.39	39.5 - 48.3	43.0 - 47.0	3.3
AL - -	65.7 ± 0.90	2.37 ± 0.63	58.6 - 72.8	61.0 - 68.0	3.6
PL - -	70.6 ± 0.66	1.76 ± 0.47	65.3 - 75.9	68.0 - 72.0	2.5
Sens. - -	64.4 ± 0.70	1.84 ± 0.49	58.9 - 69.9	62.0 - 68.0	2.8

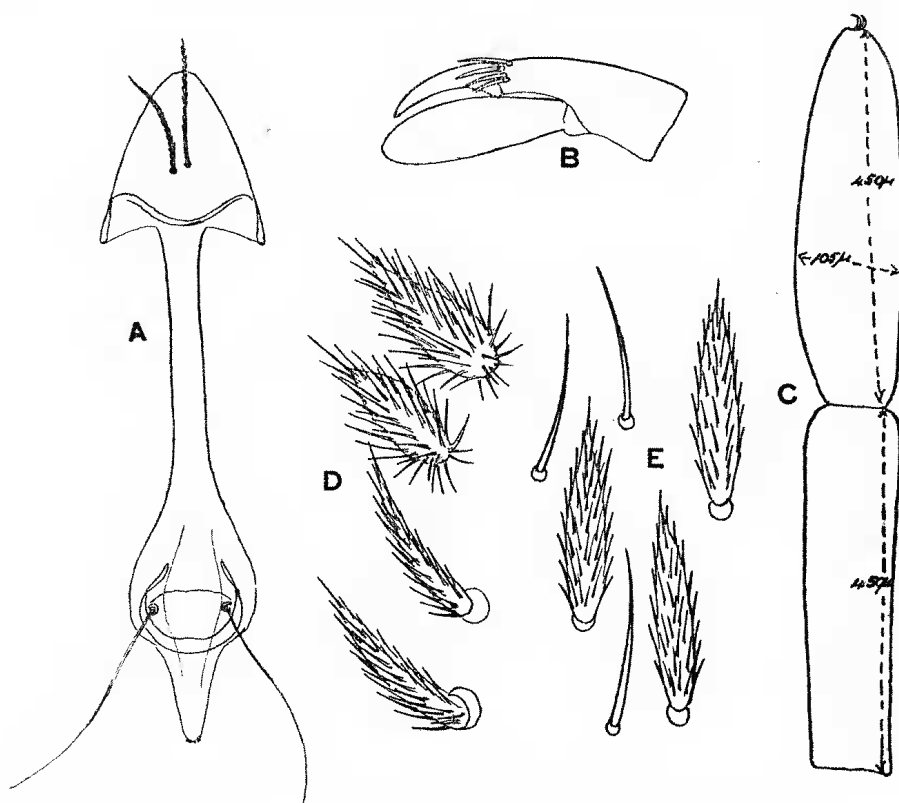


Fig. 4 *Acomatacarus longipes* n. sp. Nymph. A, crista (x375); B, palp; C, front tarsus and metatarsus (x125); D, dorsal setae (x860); E, leg setae (x860).

Nymph—Differs from other species in the form of the dorsal setae and in the relative dimensions of the front tarsi and metatarsi. In the type, one front metatarsus is slightly shorter than the other, and slightly shorter than the tarsus. In the paratype the front tarsi and metatarsi are the same on both legs. Similarly in the two specimens from honey-eaters the front metatarsi are slightly shorter than the tarsi and in one specimen both segments are much shorter than in the other, which latter agrees with the type. In the second specimen the front tarsi measure 330μ long by 60μ high, and the metatarsi 270μ long, but it agrees perfectly in the dorsal setae.

(1) In mounts of Trombiculidae and Leeuwenhoekiidae excessive compression of the normally convex larval scutum will tend to make the higher values of the Standard Data unreliable, and this should be kept in mind when considering the theoretical and observed ranges.

Acomatacarus athertonensis n. sp.

Fig. 5 A-B

Description—Larvae. Length 270μ , width 205μ . Shape broadly oval. Dorsal scutum typical of the genus, pentagonal, with the following Standard Data in microns for 16 specimens.

	Mean	Standard Deviations	Theoretical Range	Observed Range	Coeff. of Variation
AW - -	66.1 ± 0.35	1.39 ± 0.24	61.9 - 70.3	65.0 - 68.0	2.1
PW - -	77.9 ± 0.42	1.67 ± 0.29	72.9 - 82.9	75.0 - 80.0	2.1
SB - -	24.7 ± 0.16	0.66 ± 0.11	22.75 - 26.75	23.0 - 25.0	2.7
SD - -	62.3 ± 0.70	2.82 ± 0.49	53.85 - 70.75	59.0 - 68.0	4.5
A-P - -	29.0	No variation recorded			
AM - -	40.6 ± 0.36	1.45 ± 0.25	36.2 - 44.0	38.0 - 43.0	3.6
AL - -	44.1 ± 0.39	1.57 ± 0.28	39.4 - 48.8	43.0 - 47.0	3.6
PL - -	59.9 ± 0.35	1.35 ± 0.24	55.9 - 64.0	58.0 - 61.0	2.2
Sens. - -	50.0	No variation recorded			

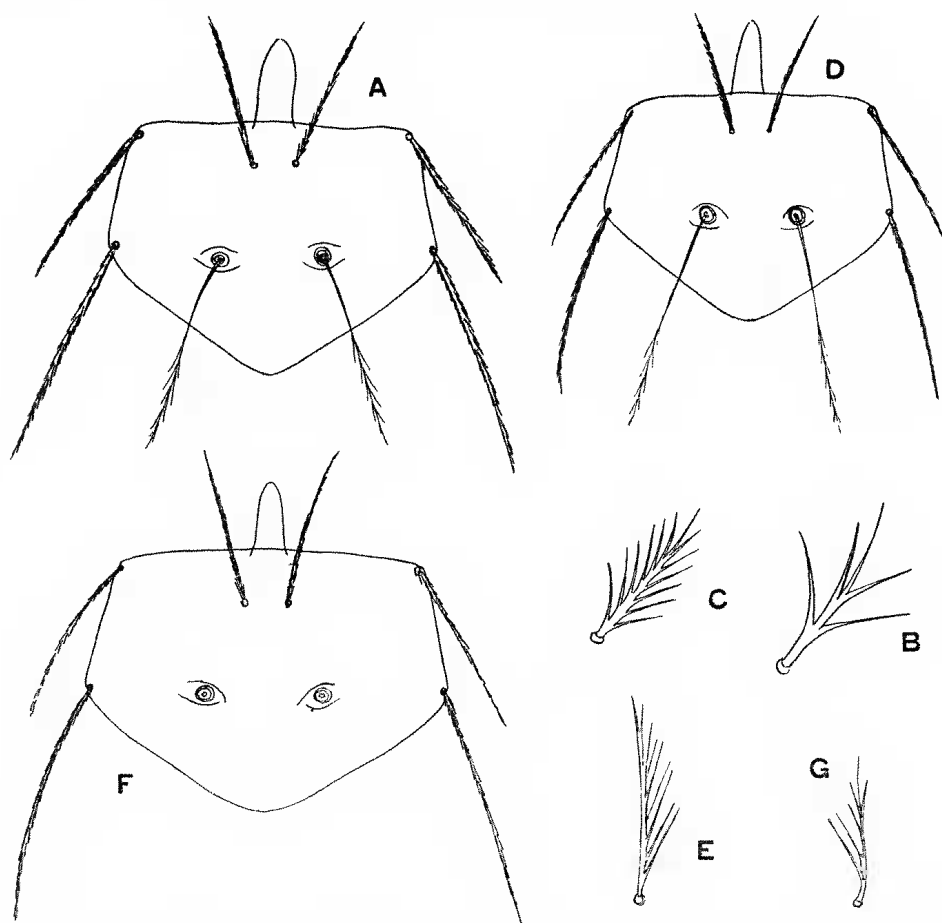


Fig. 5 Larvae A-B: **Acomatacarus athertonensis** n. sp. A, dorsal scutum (x 500), B, gnathosomal seta (x 860); C, *A. australiensis* (Hirst), gnathosomal seta (x 860), D-E, **A. echidnus** n. sp.: D, dorsal scutum (x 500); E, gnathosomal seta (x 860). F-G, **A. barrinensis** n. sp.: F, dorsal scutum (x 500); G, gnathosomal seta (x 860).

Anterior median scutal process 21μ long by 9μ wide. AM with their bases 9μ apart and situated 11μ behind anterior scutal margin. Scutal and dorsal setae strongly ciliated and rather blunt at tip. Eyes 2 + 2, about 1 diam. from postero-

lateral corners of scutum. Dorsal setae difficult to count, but ca. 66 arranged ca. 2.8(9).10.12.10.8.6.2. Ventrally without setae between coxae I, a pair between coxae III, and then ca. 8.10.14.10.6.4 = 52, the latter setae about half the length of the dorsal setae. Coxae I with 2, II and III with one seta. The pair of setae on the base of gnathosoma to 25μ , with 5 long branches. Palpi normal; femur, genu and tibia with long lightly ciliated seta, claw bifurcate, the outer fork reaching half-way to tip of inner fork, tarsus short and stumpy, normal as regards setae. Chelicerae dorsally with 3 or 4 teeth. Legs normal, tibia and tarsus III with a pair and a single whip-like seta as in other species; claws two, with a longer more slender claw-like empodium. Both true and pseudostigmal openings present.

Loc.—From fence posts, etc. Wongabel, Atherton Tableland, Queensland, Oct. 1944 (R. N. McCulloch). Described from 16 syn-types.

Remarks—This species is very close to *australiensis* Hirst in the number and arrangement of the dorsal and ventral setae and cannot be separated therefrom on these features. The Standard Data of the dorsal scutum are consistently lower, the values for AW, PW, SB, SD, A-P, PL and Sens. all being significantly different; the Difference of Means between the population of 16 specimens of *athertonensis* and the 13 specimens of *australiensis* from Chatswood, New South Wales (reported 1944), give the values of d/σ_d as follows:—AW 11.8, PW 11.9, SB 8.0, SD 7.6, A-P 4.2, AM 0.5, AL 2.25, PL 5.4, Sens. 20.8.

Besides these differences the gnathosomal setae are slightly longer, but with only 5 branches, in *athertonensis* (*cf.* fig. 5 B) than in *australiensis* which has many and shorter branches (*cf.* fig. 5 C).

The habits of these larvae are remarkable. Major McCulloch reports that they frequent fence posts and the connecting wires in large numbers, and that they are also very resistant to poisons.

Acomatacarus echidnus n. sp.

Fig. 5 D-E

Description—Larva. Shape elongate oval. Length 218μ , width 162μ . Scutum normal for the genus with the following Standard Data, derived from 7 specimens in microns.

	Mean	Standard Deviations	Theoretical Range	Observed Range	Coeff. of Variation
AW - -	57.7 ± 0.87	2.31 ± 0.62	50.8–64.6	54.0–61.0	4.0
PW - -	69.0 ± 0.38	1.0 ± 0.27	66.0–72.0	68.0–70.0	1.45
SB - -	22.1 ± 0.55	1.46 ± 0.39	17.7–26.5	21.0–25.0	6.5
SD - -	55.6 ± 0.83	2.19 ± 0.58	49.0–62.2	54.0–59.0	3.9
A-P - -	25.6 ± 0.53	1.40 ± 0.37	21.4–29.8	25.0–29.0	5.5
AM - -	31.6 ± 0.36	0.80 ± 0.25	29.2–34.0	30.0–32.0	2.5
AL - -	38.0 ± 0.82	2.0 ± 0.60	32.0–49.0	36.0–40.0	5.2
PL - -	48.8 ± 0.68	1.53 ± 0.48	44.2–53.4	47.0–50.0	3.2
Sens. - -	54.0	No variation recorded			

Dorsal setae ca. 66 and arranged 2.8.8.8.10.10.10.6.4, 40–45 μ long, ciliated and not very tapering; ventral setae, excluding the pair between coxae III ca. 42, arranged 10.8.12.8.4 and ca. 20 μ long, rather more slender than dorsal setae. Anterior median scutal process 18 μ long by 7 μ wide. AM setae 7 μ apart at bases and 9 μ behind anterior scutal margin. Chelicerae dorsally serrate. Palpi normal as in other species, with bifurcate tibial claw, setae on femur, genu and tibia slender and ciliated. Eyes 2 + 2, about 1 diam. from postero-lateral corners of scutum. Legs I 300 μ , II 252 μ and III 306 μ long, normal; tibia III with 2 long flagellate simple setae, tarsus III with 1 such. Coxae I with 2 setae, II and III with 1 seta. Ventrally gnathosoma with a pair of long, 20 μ , setae, as in fig. 5 E.

Loc.—Described from 7 syn-types taken from an echidna, on the Atherton Tableland, Queensland, 11 June 1944 (Lt.-Col. J. M. Bonin).

Remarks—In the ratio of $PW/SD = 1.24$, this species will come very close to *hirsti* Wom. 1944, but differs greatly in the number of dorsal setae and in the Standard Data, the values of which are significantly lower.

***Acomatacarus barrinensis* n. sp.**

Fig. 5 F-G

Description—Larva. Shape elongate oval. Length 252μ , width 180μ . Scutum normal for the genus with the following Standard Data in microns derived from 6 specimens.

	Mean	Standard Deviations	Theoretical Range	Observed Range	Coeff. of Variation
AW - -	73.0 ± 0.57	1.41 ± 0.32	68.8–77.2	72.0–75.0	1.95
PW - -	87.2 ± 1.01	2.48 ± 0.71	79.7–94.7	84.0–90.0	2.8
SB - -	28.5 ± 0.45	1.12 ± 0.32	25.5–31.8	27.0–30.0	4.0
SD - -	64.7 ± 0.96	2.36 ± 0.68	57.7–71.7	63.0–65.0	3.7
A-P - -	30.2 ± 0.54	1.34 ± 0.39	26.2–34.2	29.0–32.0	4.4
AM - -	40.0	No-variation recorded			
AL - -	44.3 ± 0.77	1.89 ± 0.54	38.7–49.9	43.0–47.0	4.3
PL - -	61.0	No variation recorded			
Sens. - -	Missing in all specimens				

Dorsal setae ca. 64 arranged 2.10.8.6.10.10.8.6.4, from $40\text{--}50\mu$ long, ciliated, not much tapering, scapula setae 70μ long; ventral setae, excluding the pair between coxae III, ca. 48, rather shorter and thinner than dorsal setae. Ratio $PW/SD = 1.34$. Anterior median scutal process 18μ long, by ca. 8μ wide. AM setae situated 14μ behind anterior scutal margin and with their bases 11μ apart. Eyes 2 + 2, about 1 diam. from postero-lateral scutal corner. Palpi and chelae as in preceding species. Legs I 306μ long, II 288μ , III 306μ . Claws and setae normal, tibia III with 2 and tarsus with 1 long flagellate seta. Coxae I with 2, II and III with 1 seta. Gnathosomal setae as figured (fig. 5 G).

Loc.—Described from five syn-types collected free, from Lake Barrine, Queensland, 16 Nov. 1943 (R. V. S.), and a single specimen from man, Atherton Tableland, Queensland, 8 March 1944 (R. V. S.).

Remarks—This species is very close to *athertonensis* in the number of dorsal setae, ca. 64 in each. It differs, however, in the Standard Data, the values for AW, PW and SB being very significantly different.

The following species are only known from the adult and are placed in this family on the characteristic structure of the crista. They are also here referred to the genus *Acomatacarus*, but with a certain amount of reservation until such times as other known larval genera have been reared through to the nymph.

ACOMATACARUS RETENTUS (Banks)

Rhyncholophus retentus Banks 1916, Trans. Roy. Soc. S. Aust., 40, 225, pl. xxiii, fig. 2 and 3.

Microtrombidium (Enemothrombium) retentus Wom. 1934, Rec. S. Aust. Mus., 5, (2), 193, fig. 34-37.

Calothrombium retentus Wom. 1937, Rec. S. Aust. Mus., 6, (1), 85.

Fig. 6 A-D

A careful re-examination of the syn-type material of this species in the South Australian Museum now shows clearly that it is congeneric with the nymphs of the previous species. The 3 syn-types are all adults, one at least possibly a male. The re-description is as follows:—

Re-description—Colour in life ? red. Shape apparently much as in previous species. Length 1·1–1·5 mm. (after Banks), width ca. 0·8–1·0 mm. Legs I 1,530 μ , II 1,125 μ , III ?, IV ca. 1,800 μ ; tarsus I elongate, 360 μ long by 110 μ high, metatarsus I 330 μ long. Crista elongate with a subposterior sensillary area, with paired filamentous, apparently nude, sensillae 150 μ long, with their bases 43 μ apart; from the sensillary area the crista gradually tapers towards the anterior end, where it expands into an arrow-head-like area forming a nasus and carrying two thickly ciliated setae. Eyes present, 2+2, small, on distinct ocular shields, and lying in a line midway between anterior area and sensillary area of the crista.

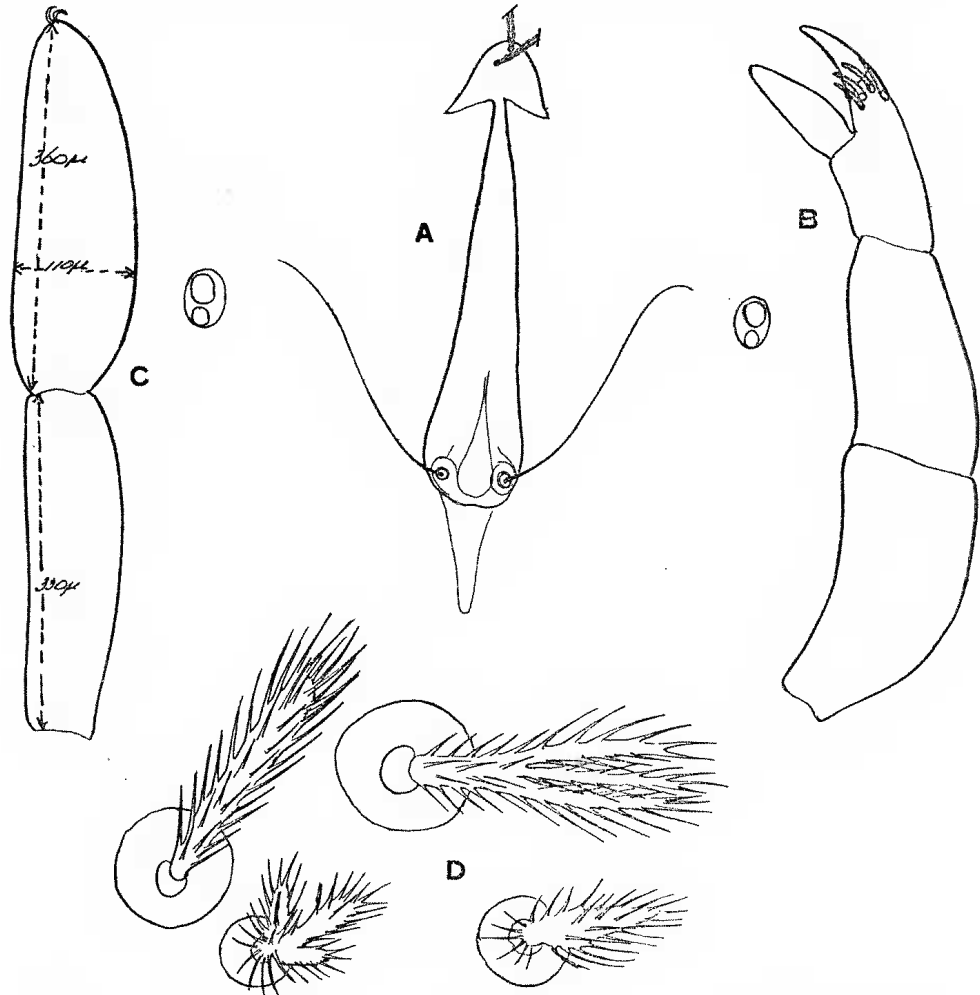


Fig. 6 *Acomatacarus retentus* (Banks). Adult. A, crista and eyes (x200); B, palp; C, front tarsus and metatarsus (x125); D, dorsal setae (860).

Palpi rather slender, tibia with strong apical claw, no accessory claw or pectines (the spines shown in Banks' figure are the normal setae and not a pectine), with 4 strong spines at base of claw (*cf.* fig. 6 B). Chelae with finely serrate, inner edge. Dorsal setae of two sizes, both large (to 56 μ) and small (to 20 μ), thick and strongly setulose, often appearing clavate due to their being bi-, tri- or quadrifurcate (*cf.* fig. 6 D).

Loc.—Only known from the original material from Victoria, and taken at Lal Lal with the ant, *Polyrachis hexacantha*, and at Sea Lake and Ocean Grove with *Iridomyrmex nitidus*.

ACOMATACARUS ATTOLUS (Banks)

Rhyncholophus attolus Banks 1916, Trans. Roy. Soc. S. Aust., 40, 225, pl. xxiii, fig. 6.

Microtrombidium attolus Wom. 1934, Rec. S.A. Mus., 5, (2), 189, fig. 24-27.

Microtrombidium (Dromeothrombium) attolus Wom. 1937, Rec. S.A. Mus., 6, (1), 86; *ibid*, 7, (2), 176. Fig. 7 A-D

This species is re-described from the syn-type material.

Re-description—Length 1.2 mm. (after Banks). Eyes according to Banks one on each side, but are not now visible in the preparations of syn-types. If present, then they are probably two small ones on each side, as in *retentus*.

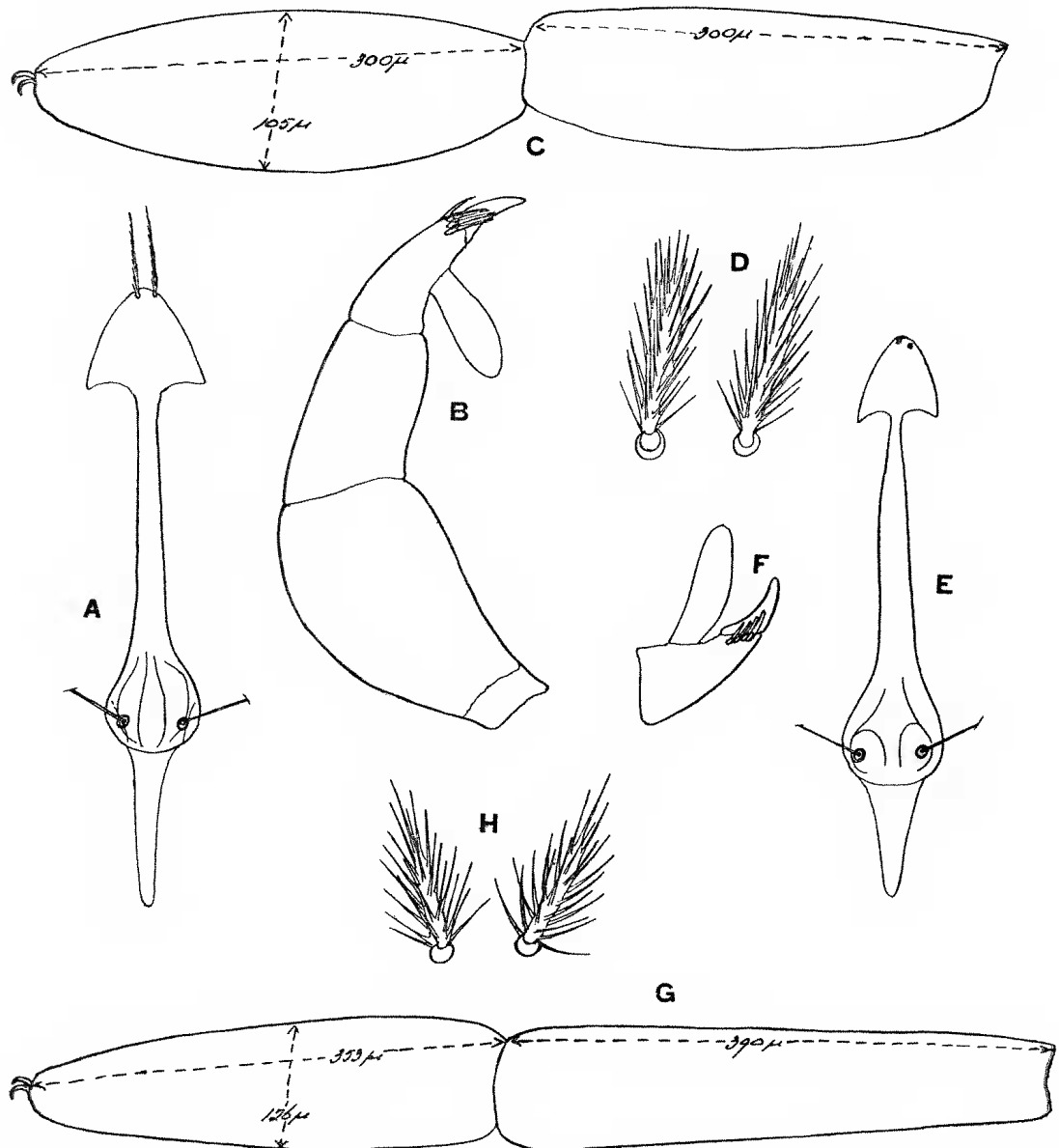


Fig. 7 A-D, *Acomatacarus attolus* (Banks). Adult. A, crista (x200); B, palp; C, front tarsus and metatarsus (x200); D, dorsal setae (x860). E-H, *A. patrius* n.sp.: E, crista (x200); F, palpal tibia; G, front tarsus and metatarsus (x200); H, dorsal seta (x860).

Crista as in fig. 7 A, ca. 300μ long with SB 36μ apart; otherwise as in the genus. Legs I ca. $1,500\mu$ long, II $1,125\mu$, III $1,035\mu$, IV $1,980\mu$; tarsus I almost as long as metatarsus, 300μ long by 105μ high, metatarsus 300μ long. Palpi slender as in fig. 7 B. Dorsal setae uniform, fairly thick and not tapering, with long setules, not furcate as in *retentus*, to 30μ long, tending to be more slender and a little longer laterally, posteriorly and near suture and crista (fig. 7 D).

Loc.—Only known from the original material from Sydney, New South Wales, and taken with the ant *Ponera lutea*.

***Acomatacarus patrius* n. sp.**

= *Dromeothrombium dromus* Wom. 1939, Trans. Roy Soc. S. Aust., 63, (2), 51 (in part).

Fig. 7 E-H

Description—Adult. Colour in life white. Shape as in other species of the genus. Length 1.7 mm., width 1.35 mm. Legs I $1,770\mu$, II $1,125\mu$, III $1,275\mu$, IV $1,900\mu$; tarsus I elongate, distinctly shorter than metatarsus, 353μ long by

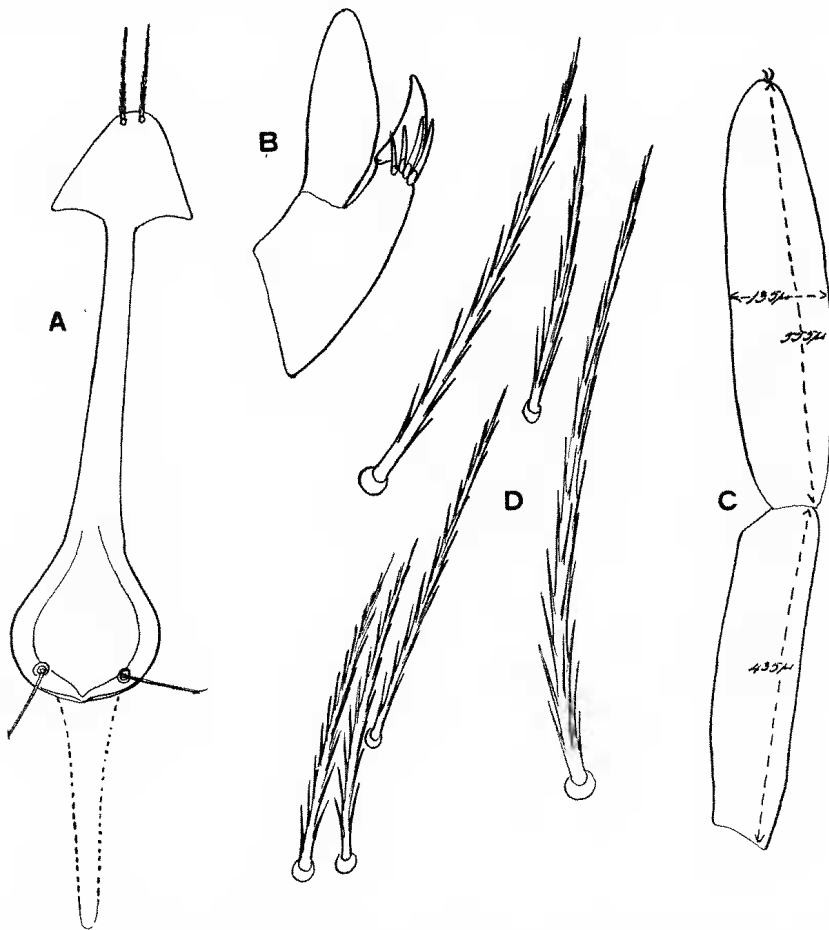


Fig. 8 *Acomatacarus dromus* (Wom.). Adult. A, crista (x 200); B, palpal tibia; C, front tarsus and metatarsus (x 125); D, dorsal setae (x 860).

126μ high and gradually narrowing apically, metatarsus 390μ long. Crista linear, 340μ long, with subposterior sensillary area, with two long filamentous sensillae, their bases 43μ apart; anterior end expanded into a broad arrow-head-like area with the usual two ciliated setae apically. Chelae with finely serrate inner edge.

Palpi elongate, tibia with strong apical claw and 4 straight stout spines at base of claw; tarsus elongate, over-reaching tip of claw. Eyes absent. Dorsal setae uniform, to 20μ , tapering posteriorly and near suture and crista.

Loc.—Type. One specimen from under a stone, Murray Bridge, S. Aust., in mallee country, 25 May 1938 (R. V. S.). Two other adults associated with ants, Burra, S. Aust., 4 Aug. 1940 (J. S. W.).

Remarks—This species is very close to *attolus* Banks, and my material has been so labelled for some time. It differs, however, in the ratio of length of front tarsus to metatarsus and in the form of the dorsal setae.

ACOMATACARUS DROMUS (Wom. 1939)

Dromeothrombium dromus Wom. 1939, Trans. Roy. Soc. S. Aust., 63, (2), 151, E-G (in part).

Fig. 8 A-D

Re-description—Adult. Length 2.4 mm., width 1.3 mm. Colour in life white. Legs I and IV very long, IV much longer than body, I $2,400\mu$ (not 3.32 mm. as reported in 1939 in error), II $1,000\mu$, III $1,800\mu$, IV $2,700\mu$, tarsus I elongate 555μ long by 135μ high, metatarsus 435μ long. Eyes absent. Crista as in fig. 8 A, 430μ long with long, filamentous sensillae with bases 54μ apart on a subposterior sensillary area; anterior end expanded to an arrow-head-like shape, with 2 ciliated setae. Chelae with serrated inner edge. Palpi slender, tibia as in fig. 8 B with 4 spines at the base of claw, tarsus stout and over-reaching tip of claw. Dorsal setae long, slender, tapering with rather short adpressed setules, of two lengths $40-50\mu$ and to 90μ (fig. 8 D).

Loc.—The type and 4 paratypes from Long Gully, S. Aust., 18 Aug. 1938, associated with ants (H. W.).

Remarks—The previous description was drawn up from a complex of species and should be disregarded. This species is abundantly distinct in the dorsal setae.

KEY TO THE NYMPHS AND ADULTS OF *Acomatacarus*

- | | | |
|---|---|---|
| 1 | Eyes present, two or ? one on each side. | 2 |
| | Eyes absent. | 3 |
| 2 | Dorsal setae of two sizes, to 20μ and to 56μ , thick with long outstanding setules, often bi-, tri- or quadrifurcate and appearing clavate. Eyes 2+2, small, on ocular shields. | |
| | <i>A. retentus</i> (Banks 1916) | |
| | Dorsal setae uniform, to 30μ , thick and not tapering distally, with fairly long setules. Front tarsus and metatarsus equal in length. Eyes ? 1+1. | |
| | <i>A. attolus</i> (Banks 1916) | |
| 3 | Dorsal setae of two lengths, to $45-50\mu$ and to 90μ , long and slender, tapering, with rather short adpressed setules. Front tarsus longer than metatarsus. | |
| | <i>A. dromus</i> (Wom. 1939, in part) | |
| | Dorsal setae more or less uniform, much shorter. | 4 |
| 4 | Dorsal setae on small platelets, thick, curved, tapering with few setules. Front tarsus longer than metatarsus. | |
| | <i>A. nova-guinea</i> (Wom. 1944) | |
| | Dorsal setae not on platelets. | 5 |
| 5 | Front tarsus shorter than metatarsus. Dorsal setae slender, tapering, with long setules, to 20μ long (<i>cf.</i> fig. 7 H). | |
| | A. patrius n. sp. | |
| | Front tarsus and metatarsus equal. Dorsal setae to 30μ long, bushy and decumbent with finer ciliations (<i>cf.</i> fig. 4 D). | |
| | A. longipes n. sp. | |
| | Front tarsus longer than metatarsus. Dorsal setae $25-40\mu$ long, with very long outstanding setules (<i>cf.</i> fig. 1 D). | |
| | <i>A. australiensis</i> (Hirst 1925) | |

KEY TO THE AUSTRALIAN AND NEW GUINEA LARVAL SPECIES OF
Acomatacarus Ewing

- 1 Tibiae and tarsi of leg III with some long simple whip-like setae. 2
No such long whip-like setae on tibiae and tarsi of leg III. Scutum small and relatively shallow PW/SD = 1.74. AW 62.15 ± 4.45 , PW 82.4 ± 5.3 , SB 28.6 ± 3.0 , SD 49.1 ± 4.0 , A-P 27.6 ± 3.9 , AM 20.9 ± 1.1 , AL 29.9 ± 3.3 , PL 40.8 ± 4.0 , Sens. 64.3 ± 4.4 . DS relatively short, straight and blunt at apex, 42 in number. *A. southcotti* (Wom. 1944)
- 2 Scutum relatively shallow, PW/SD greater than 1.3. 3
Scutum relatively deeper, PW/SD smaller than 1.3. 7
- 3 DS between 50 and 60 in number. 4
DS between 60 and 80 in number. 5
- 4 DS 52-54. PW/SD = 1.335, AW 76.4 ± 5.9 , PW 92.4 ± 3.6 , SB 28.8 ± 4.4 , SD 69.2 ± 1.2 , A-P 32.8 ± 1.2 , AM 41.2 ± 4.4 , AL 37.8 ± 2.9 , PL 59.8 ± 7.7 , Sens. 63.0 ± 5.2 . *A. adelaideae* (Wom. 1944)
DS 56-58. PW/SD 1.33, AW 86.6 ± 9.3 , PW 96.7 ± 6.7 , SB 30.4 ± 3.1 , SD 72.7 ± 7.8 , A-P 31.6 ± 3.1 , AM 43.9 ± 4.3 , AL 65.7 ± 7.1 , PL 70.6 ± 5.3 , Sens. 64.4 ± 5.5 . *A. longipes* n.sp.
- 5 DS 76. PW/SD = 1.32. AW 77.3 ± 14.2 , PW 93.4 ± 14.3 , SB 30.2 ± 6.1 , SD 70.8 ± 10.5 , A-P 31.9 ± 5.3 , AM 44.9 ± 9.8 , AL 49.0 ± 9.6 , PL 63.6 ± 8.2 , Sens. 64.0 ± 8.3 . *A. australiensis* (Hirst 1925)
DS 62-64. 6
- 6 DS 62. PW/SD = 1.32. AW 85.7 ± 14.0 , PW 98.4 ± 12.3 , SB 27.9 ± 6.8 , SD 73.0 ± 15.6 , A-P 34.2 ± 10.4 , AM 41.5 ± 8.9 , AL 62.1 ± 17.5 , PL 72.8 ± 7.7 , Sens. 58.7 ± 12.6 . *A. nova-guinea* (Wom. 1944)
DS 64. PW/SD = 1.34. AW 73.0 ± 4.2 , PW 87.2 ± 7.4 , SB 28.5 ± 3.3 , SD 64.7 ± 7.0 , A-P 30.2 ± 4.0 , AM 40.0 , AL 44.3 ± 5.7 , PL 61.0 , Sens. ?.
A. barrinensis n.sp.
- 7 PW/SD 1.194, DS ca. 70. AW 64.0 ± 5.2 , PW 81.0 ± 6.0 , SB 25.0 , SD 71.0 ± 8.5 , A-P 32.5 ± 2.6 , AM 36.5 ± 2.6 , AL 38.0 ± 6.0 , PL 54.0 , Sens. 44.3 ± 5.7 . *A. mccullochi* (Wom.)
PW/SD ca. 1.24 - 1.25. 8
- 8 DS ca. 82 in number. PW/SD 1.25. AW 79.0, PW 97.0, SB 29.0, SD 77.5, A-P 36.0, AM 43.0, AL 43.0, PL 54.0, Sens. 72.0. *A. hirsti* (Wom. 1944)
DS ca. 66. 9
- 9 PW/SD = 1.24. AW 57.7 ± 6.9 , PW 69.0 ± 3.0 , SB 22.1 ± 4.3 , SD 55.6 ± 6.6 , A-P 25.6 ± 4.2 , AM 31.6 ± 2.4 , AL 38.0 ± 6.0 , PL 48.8 ± 4.6 , Sens. 54.0.
A. echidnus n.sp.
PW/SD = 1.25. AW 66.1 ± 4.2 , PW 77.9 ± 5.0 , SB 24.7 ± 1.9 , SD 62.3 ± 8.4 , A-P 29.0, AM 40.6 ± 4.3 , AL 44.1 ± 4.7 , PL 59.9 ± 4.0 , Sens. 50.0.
A. athertonensis n.sp.

In this key the theoretical range as expressed by Mean $\pm 3\sigma$ is given.

Genus NEOTROMBIDIUM Leon. 1901

Leonardi, 1901 Zool. Anz., 25, 18; Berlese 1912, Redia, 8, (1), 49.

Neotrombidium was first erected by Leonardi as a subgenus of *Trombidium* on the supposed absence of the crista and on the presence of a single eye on each side. The type was *Trombidium (Neotrombidium) furcigerum* Leon. from South America.

Berlese in his Monograph, 1912, showed that Leonardi was in error, in that in *furcigerum* a crista and two eyes on each side were present. Berlese raised *Neotrombidium* to generic rank on the following diagnosis:—"Body elongate, abdomen with well developed shoulders. Cephalothorax small, elongate, conical, densely setose. Crista linear, with a posterior rhombic sensillary area. Nasus present. Eyes sessile, difficult to see. Palpi small, with a series of subapical

spines on the fourth segment; tarsus small, elongate, conical. Legs small and slender, shorter than body. Dorsal setae peculiar, trifurcate, fork with short peduncle and rami long-pointed, sub-barbate. Setae of legs simple, spiniform and nude."

Besides the type species Berlese also described *T.* (*Neotrombidium*) *ophthalmicum* from South America. In 1928 Hirst (Ann. Mag. Nat. Hist., (10), 1, 563-571) described *Neotrombidium barringtonense* from Barrington, New South Wales, and in 1936 I recorded it from South Australia.

In 1935 in his revision of the subfamilies of the Trombidiidae Sig Thor included *Neotrombidium* in the Microtrombidiinae. It is now evident, however, that in the form of the crista with the anterior end expanded into a more or less round or conical nasus carrying two setae, the genus is closely allied to the nymphs and adults now known to belong to the genus *Acomatacarus* of the Leuwenhoekiidae.

The Australian species is herewith re-described and details figured.

NEOTROMBIDIUM BARRINGTONENSE Hirst 1928

Hirst 1928, Ann. Mag. N. Hist., (10), 1, 561-671; Womersley 1934, Rec. S. Aust. Mus., 5, (2), 185; *idem* 1936, J. Linn. Soc. Zool., 40, 107.

Fig. 9 A-E

Re-description of Type—Adult. Elongate, broadest across shoulders, then narrowed and parallel-sided to the apex which is rounded, propodosoma small and

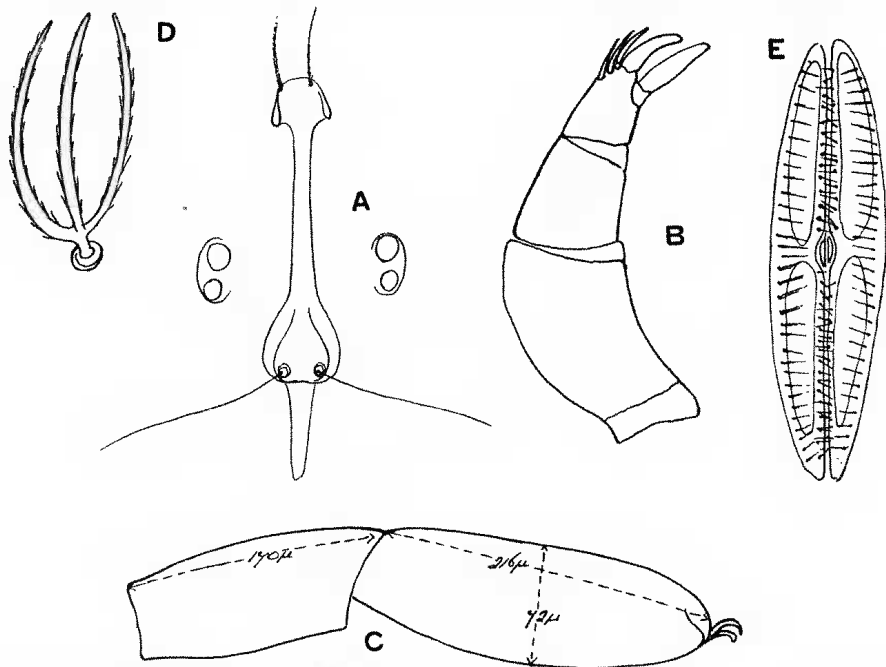


Fig. 9 *Neotrombidium barringtonense* Hirst. Adult. A, crista and eyes (x200); B, palp, C, front tarsus and metatarsus (x200); D, dorsal seta (x860); E, genital opening of adult egg-bearing female.

conical-triangular. Colour in life red. Length 1.8 mm., width .9 mm. Crista linear, 240 μ long, with anterior end enlarged to form a more or less rounded nasus with two long setae; with subposterior sensillary area with two long filamentous sensillae with bases 18 μ apart. Eyes 2+2, on distinct shields, in

advance of sensillary area, and about 2 diams. therefrom, the posterior eye the smaller. Chelicerae sickle-shaped, inner edge only indistinctly and finely serrate. Palpi small and rather slender, tibia with strong curved apical claw, no accessory claw or pectines, but with 2 or 3 strong spines at base of claw; tarsus elongate and over-reaching tip of claw. Legs all shorter than body, I 930μ long, II 570μ , III 660μ , IV 820μ ; tarsus I elongate, 216μ long by 72μ high, metatarsus I 170μ long. Dorsal setae uniform to 35μ long, trifurcate, with very short peduncle, the forks shortly and rather indistinctly barbed or ciliated. Leg setae simple. Genital opening very elongate, 280μ with only two pairs of discs, which themselves are elongate (cf. fig. 9 E).

Loc.—New South Wales: Barrington, June 1927 (S. Hirst), (type locality); also under eucalypt bark, Bathurst, 31 May 1934 (S. L. A.). South Australia: Menindie, 2 July 1928 (S. Hirst); Long Gully, 12 May 1934 (H. W.); Belair, Jan. 1935 (H. W.); under bark, Monarto South, April 1943 (H. W.), in numbers; Robe, by sweeping, July 1943 (H. W.). Queensland: Biloela, Feb. 1943 (Horn.).

Remarks—All these specimens have only two pairs of characteristically elongate oval genital discs and might therefore have been assumed to be only in the nymphal stage, as is the case in most of the Trombidiids. One of the specimens, however, is an adult female, carrying a number of eggs. Two pairs only of genital discs in the adult is therefore not only characteristic of this species, but probably also of the genus. The genital opening also is extraordinarily elongate and situated between the second coxal groups.

SUMMARY

In 1944 (Trans. Roy. Soc. S. Aust., 68, (1), 102) the subfamily Leeuwenhoekinae was erected for the genus *Leeuwenhoekia* Ouds., on the presence in the larvae of a pair of true stigmata with tracheae, situated one on each side between the gnathosoma and coxae I. Except possibly in the allied genus *Hannemannia* Ouds. these true stigmata were absent from all other genera of the Trombiculinae, but are now shown to be present in that genus.

As the nymphs of the three larval species of *Leeuwenhoekia*, *australiensis* Hirst, *nova-guinea* Wom. and *longipes* n. sp. have now been reared, it is shown that these also differ from the nymphs of other genera of Trombiculinae. The nymphs are of an entirely different body shape and lack the characteristic median constriction typical of the Trombiculids. The crista is distinct in having an expanded arrow-head-like anterior nasus, furnished with a pair of setae homologous with the antero-median setae of the larval scutum.

In addition to these nymphs, four species of adults, one new, the others previously placed in genera of the Microtrombidiinae are, on the shape and form of the crista, shown to be related.

On these characters therefore the Leeuwenhoekinae is raised to Leeuwenhoekidae.

Ewing's (1944) separation of *Leeuwenhoekia* Ouds. into three genera is accepted and the Australian and New Guinea species now placed in *Acomatacarus* Ewing.

Ten larval species, of which three are known as nymphs and four adult species are recognised.

The genus *Neotrombidium* Leonardi 1901 with the Australian species *N. barringtonense* Hirst, with a similar form of crista is included in the Leeuwenhoekidae. It differs from the only other nymphal and adult genus known, *Acomatacarus*, in having two instead of three pairs of genital discs in the adult, and these very elongate.